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0191 DA

PRE DESIGN REVIEW

SCOPE

- Establish feasibility of HILS approach
- Approve light pack design concepts
- Approve tracking system design concepts
- Investigate trade offs presented

RESULT

- Establish configuration for final design

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STUDY PHASE - OPTICAL

HAS ACCOMPLISHED

- BACKGROUND LUMINANCE
- SUBSTITUTION OF STRAIGHT FLUORESCENT LAMPS
- RETENTION OF ELECTRICAL MASKING
- USE OF TUNGSTEN AS LIGHT SPOT SOURCE
- COLOR BALANCE AND RENDERING
- CONFIGURATION OF LIGHT PACK

THREE LAMPS HAVE BEEN REVIEWED

- TUNGSTEN - TRU FOCUS TYPE (HALOGEN)
- MARC 300
- XENON ARC
  - INBOARD
  - OUTBOARD

PREFERENCE DIRECTED TO TUNGSTEN LIGHT PACK

- LOWER OPERATING COST
- MINIMUM RECURRING COST
- EASE IN REPLACEMENT
- MINIMUM ELECTRIC INPUT POWER
- SAFETY
- SIMPLEST CONFIGURATION
- EXTRA HIGH COLOR RENDERING
- MINIMUM POWER REQUIREMENTS

SYSTEM IS VERSATILE

- LUMINANCE CAN BE INCREASED BY
  - VOLTAGE INCREASE AS FOR B/W OR COLOR FILM
  - COLOR FILTERS REMOVAL FOR B/W FILM
  - COLLIMATOR SUBSTITUTION TO REDUCE SPOT SIZE
  - VIEWING SCREEN GAIN CHANGE

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BACKGROUND LIGHTING GOALS

1) 2000 FT. LAMBERTS MINIMUM

2) UNIFORMITY COMPARABLE TO EXISTING MLT EXCLUDING CONTRIBUTION OF HILS

3) RETAIN ELECTRIC MASKING CONTROL

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BACKGROUND LIGHTING STUDY RESULTS

STUDIED TWO APPROACHES

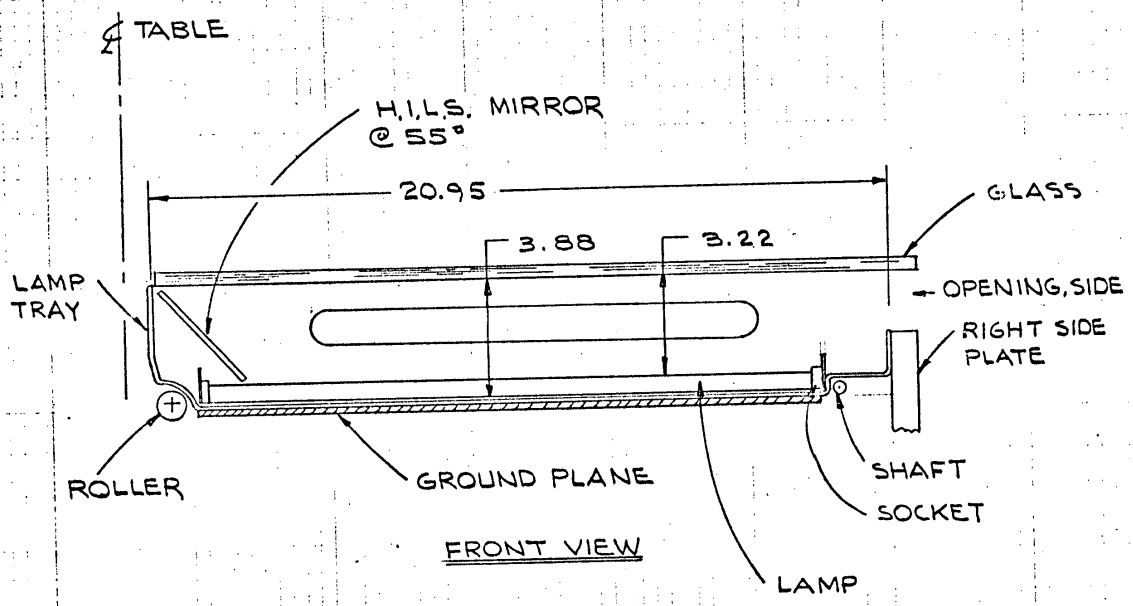
1) Curved lamps
2) Shortened straight lamps

SELECTED SHORTENED STRAIGHT LAMPS - Fulfills goals with TR-70 screen

1) 2000 ft. lamberts at center measured with GFE Weston meter
2) Retain intensity control on background lighting
3) Background fluorescents provide along center a luminance distribution with minimum of 2000 ft. lamberts at 4" from center edge and does not drop below 45% 1/2" from center edge as measured with GFP Weston and excluding effect of HILS pack.

SOLUTION - See Sketch 1

1) Short straight lamps of identical phosphor and diameter as existing MLT.
2) High reflecting mirror at one end of lamps center edge of lamp cavity or light tray tilted 55° up from horizontal.



CONFIG. 1—H.I.L.S. BACKGROUND LAMP

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LIGHT PACK STUDY GOALS

- 25,000 FOOT LAMBERTS
- 20% MAXIMUM VARIATION OVER AREA WITHIN 2-3/4" SPOT
- 2-3/4" SPOT
- CORRELATED COLOR TEMPERATURE 5000°K ± 500
- CRI MINIMUM OF 70
- $\bar{x}$, $\bar{y}$ CHROMATICITY AIM POINTS
- INTENSITY CONTROL CONTINUOUSLY VARIABLE 1500-25,000 FT. LAMBERTS
- HEAT AT FILM OF 2.0 DENSITY 30°F ABOVE AMBIENT AT 25,000 FT. LAMBERTS
- 8" x 15" CENTRAL AREA
- FILL NUMERICAL APERTURE EFFECTIVELY

25X1

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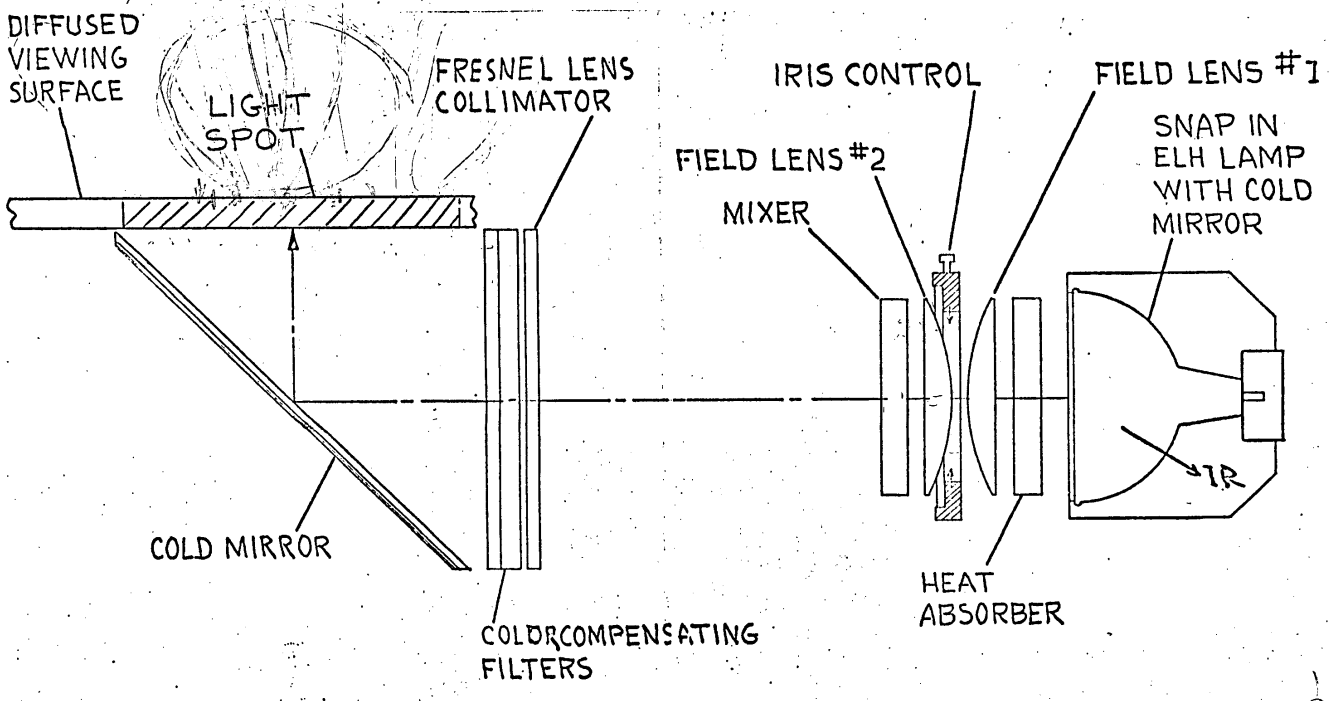
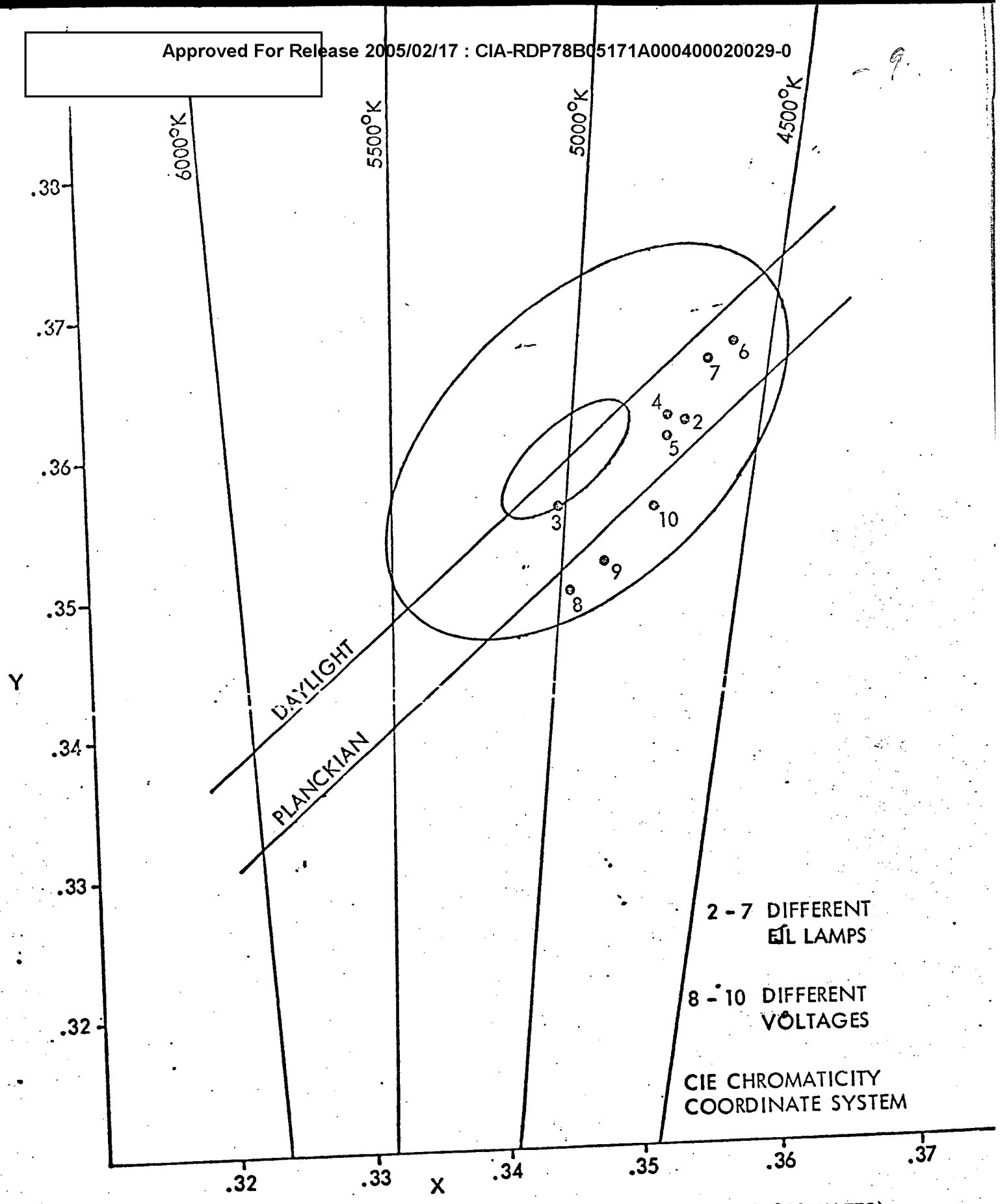
SUMMARY TUNGSTEN LIGHT PACK

VIEWING SURFACE DIFFUSER	Polacoat TR-70
LAMP	ELH 300 watt, 120 volt rated, 110 operating volts
LIFE	Nominal 100 hours at operating volts, $.09/hour operating cost
REPLACEMENT	Snap in
LUMINANCE	25,000 ft. lamberts peak color corrected
INTENSITY CONTROL	To 1500 ft. lamberts color corrected iris control
SPOT SIZE	Overall 3" diameter
UNIFORMITY	25% over 2-1/2" effective diameter 30% over 2-3/4" effective diameter
COLOR	ILLEGIB
°K	4800°K nominal - minimum 4500°K
Color Rendering Index	80+
Chromaticity Air Points	x = .350, y = .365 nominal
IRRADIANCE	At 10" height 2 x 10^{-3} watt/cm^2
FILM TEMPERATURE	At 25,000 ft. lamberts
Spot only	22°F above ambient
Surround	maximum 30°F above ambient
LUMINANCE	Through B&L microscope, 10x ocular, 3x ASR, 3x zoom = 560 ft. lamberts approximate
VERSATILITY	For black and white film
Remove color filter, luminance,	120,000 fl
plus	
Substitute higher gain diffuser	210,000 fl
or	
Retain color correction and substitute higher gain diffuser	45,000 fl corrected
Max. luminance possible thru microscope (at 210,000 fl)	4,600 fl

CONFIGURATION-
HIGH INTENSITY LIGHT PACK





RANGE AND COLOR CORRECTION EJL LAMPS (200 WATTS)

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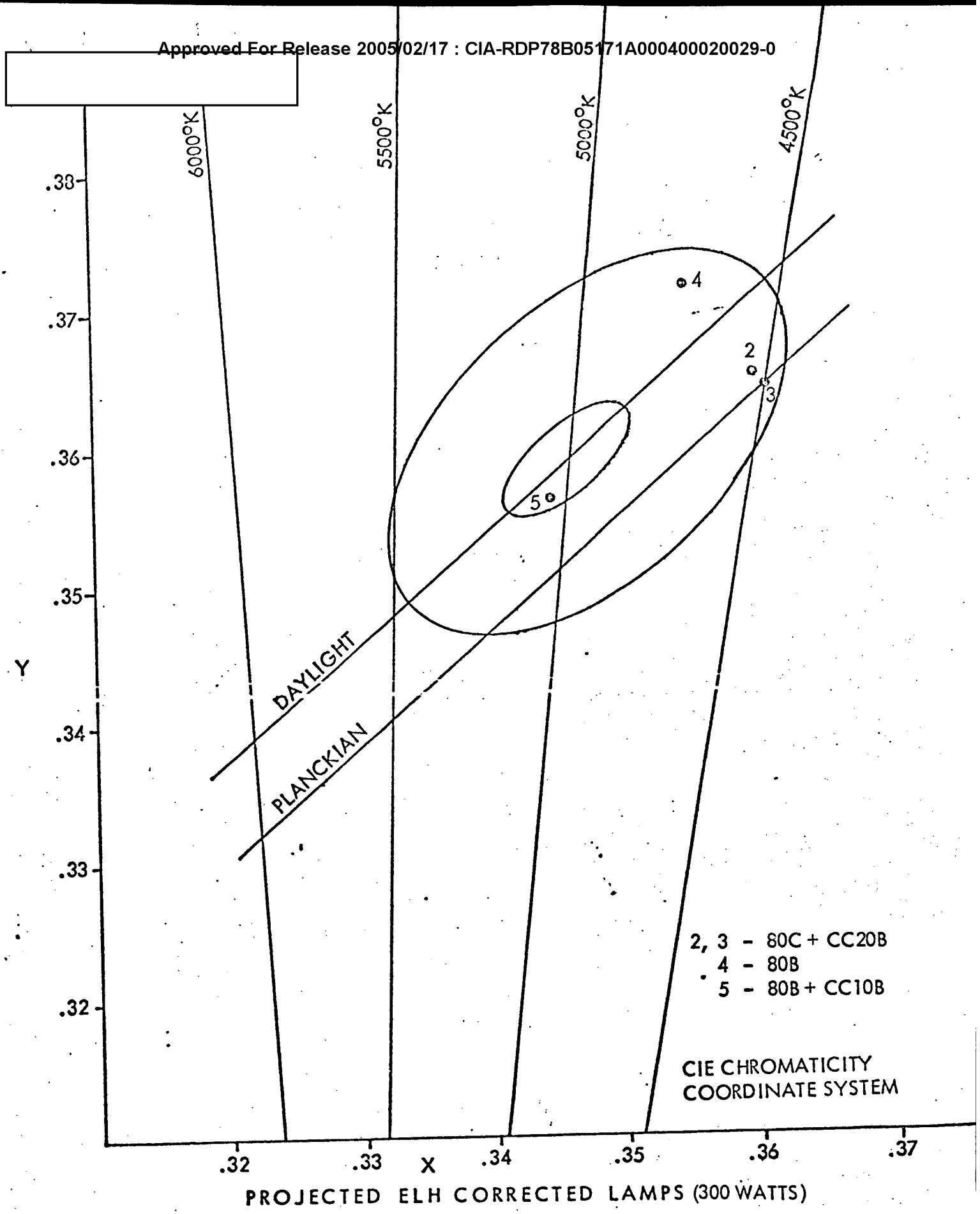
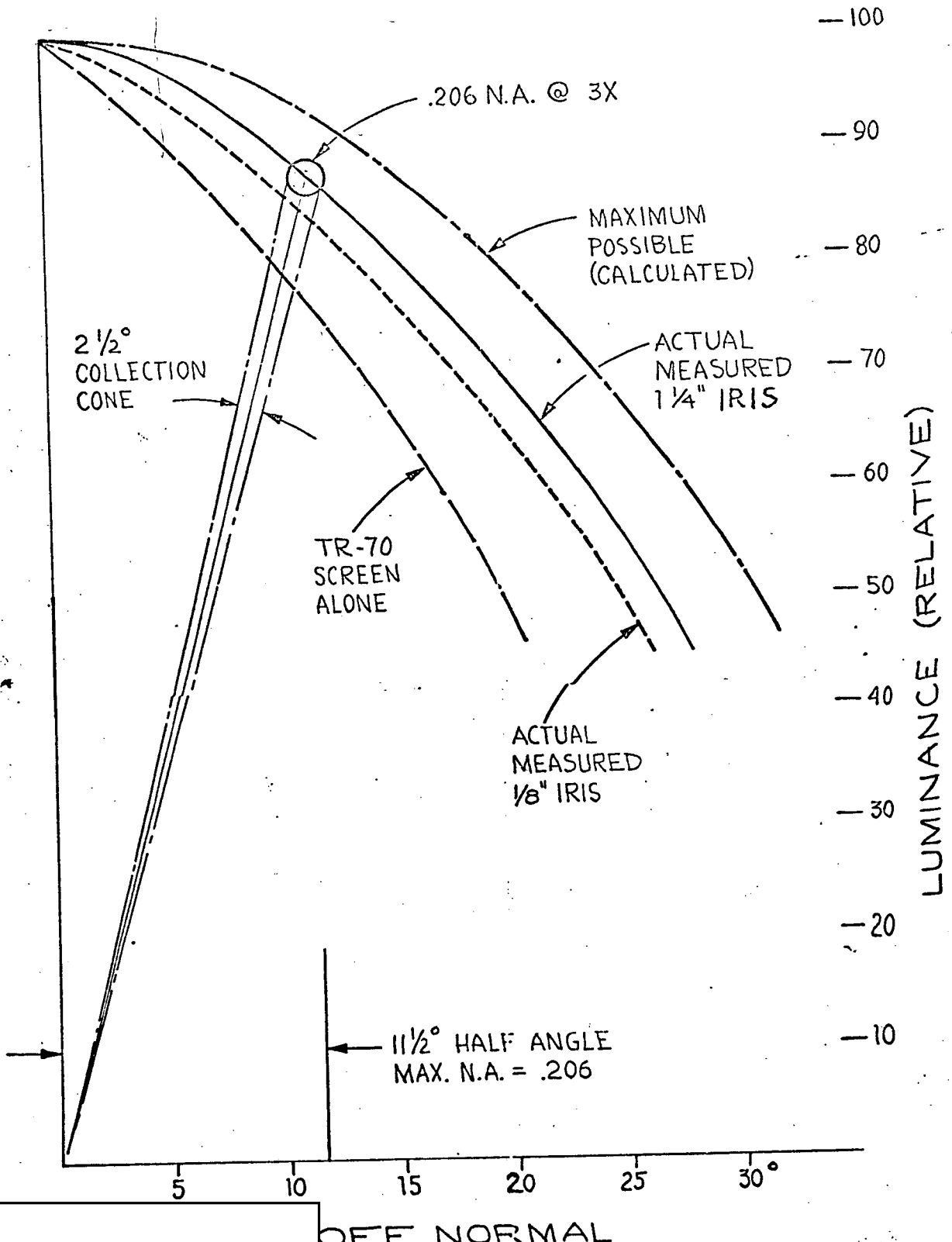


POLAR PLOT OF LUMINANCE VS ANGLE FROM NORMAL



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TECHNICAL SUMMARY OF XENON ARC PACK

ILLEGIB

[redacted]

[redacted]

ILLEGIB

(2) Lamp ILC 300 watt Sapphire envelope	(2) Lamp PEK 500 watt Ozone free quartz
(2) Power Supply - 400 watt 18x18x9", 90 lbs. each	(2) Power Supply - 600 watt 24x12x12", 120 lbs. each
(2) Igniters - 5-1/2x5-1/2x4" 8 lbs. each, 20KV	(2) Igniters - 5-1/2x5-1/2x4" 8 lbs. each, 30 KV
Lamp length < 2-1/2"	Lamp length 5.8"
Life - 500 hours, 40¢/hr - 20¢/hr	Life - 1000 hours, 15¢/hr - 10¢/hr.
Intensity - 750 cdles.	Intensity - 1600 cdles.
Special development req'd (Ozone gas seal)	
Intensity control - Neutral density disk	Neutral density disk

Calculated Performance

Luminance		
Peak	14,000 ft. lamb.	30,000 ft. lamb.
Uniformity	30%	20%
Color		
Temperature	5500°K	5500°K
CRI	80+	80+

Slow flicker from arc wandering

ILLEGIB

ILLEGIB

[redacted]

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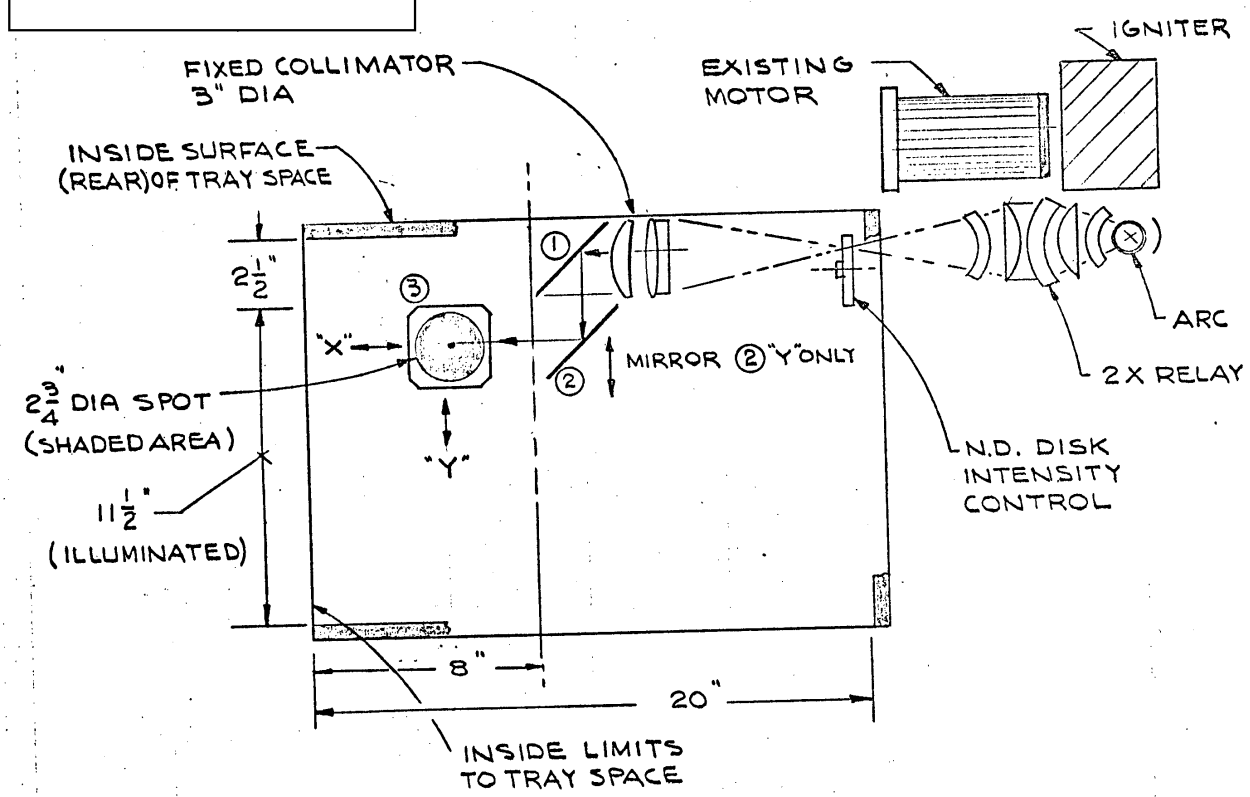
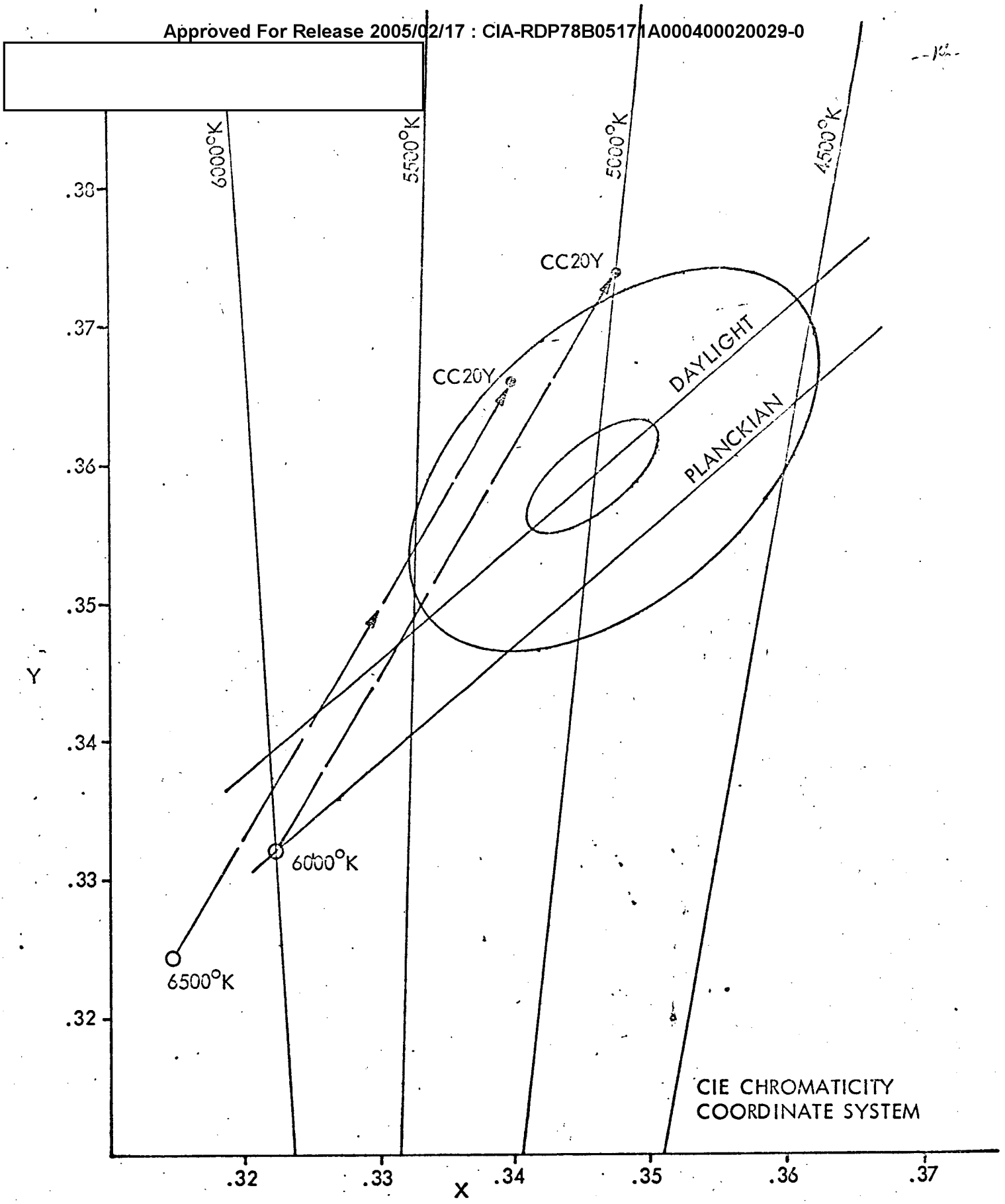


XENON ARC - OUTBOARD CONFG.



CORRECTED XENON ARC LAMPS (TYPICAL)

ILLEGIB

SUMMARY LIGHT PACK

[redacted]

	TUNGSTEN	ARC OUTBOARD
LAMP	300 watt	500 watt
LIFE	100 hours	1000 hours
LUMINANCE	25,000 fl	30,000 fl
MAX. LUMINANCE (Uncorrected)	120,000 fl	55,000 fl
COLOR TEMPERATURE	4800°K	5500°K
TOTAL SIZE (per table)	< 1 ft^3	~ 5 ft^3
WEIGHT	< 10 lb.	~ 250 lbs.
POWER	~ 600 w	~ 1200 w
OPERATING COST (one side)	[redacted]	
LAMP COST		25X1
POWER SUPPLY		
OPTICS		ILLEGIB

Light Pack Components for Prototype [redacted] 25X1

Power Supply and Optics [redacted]

[redacted]

ILLEGIB

25X1

CONFIGURATION GOALS

HILS COVERAGE - 8" x 15"

HILS TO TRACK MICROSCOPE RHOMBOIDS

EACH HILS TO BE USABLE ALONE

MANUAL POSITION CONTROL FOR EACH HILS

SEPARATE ON/OFF & DIMMING CONTROLS FOR EACH HILS

NO CHANGE IN VIEWING SURFACE HEIGHT

MINIMUM SHADOWING FROM HILS

PARKING ABILITY

25X1

[redacted]

CONFIGURATION STUDY PHASE RESULTS

HILS COVERAGE	8" x 13"
MOTION SYSTEM	DC gear head motors capable of driving the HILS in X and Y from 0 to 1"/sec. Will operate normally when table is tilted.
TRACKING SYSTEM	Positive position servo to the bridge. Position transducers will be located on the bridge and each HILS.
MANUAL CONTROL	X and Y position potentiometers will be provided for each HILS.
PARKING	A Park/Track switch for each HILS will be provided. The Park position will move the HILS to the Rear Center of the viewing surface.
POWER	An ON/OFF switch will be provided for each HILS. The power switch will also control the fan for each HILS.

25X1

COOLING GOALS

FILM PLANE	$\leq$ 110°F or 30°F above ambient
TEST CONDITION	66% of glass covered by 2.0 density film

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STUDY PHASE RESULTS

COOLING

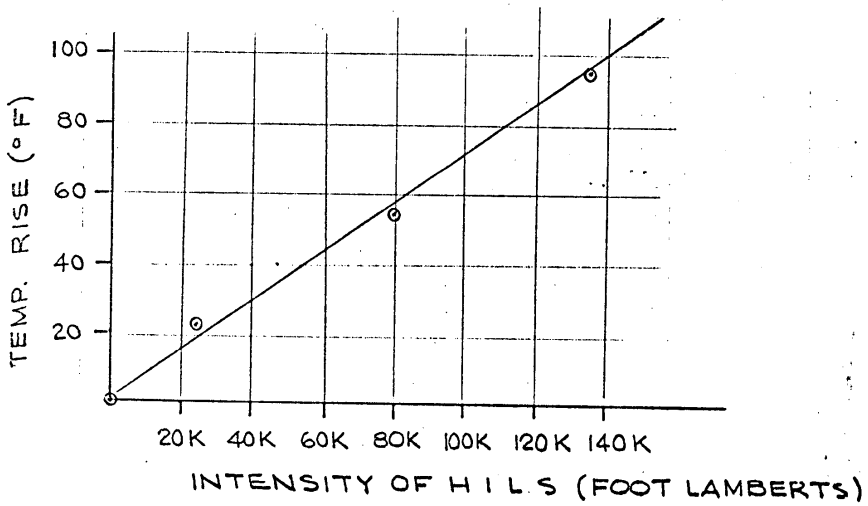
FILM TEMPERATURE - measured in center of HILS Spot operating at 25,000 ft. lamberts with background at ft. lamberts — 22°F Above Ambient

TEMPERATURE OF SURROUNDING FILM - measured as above — 30°F Above Ambient max.

COOLING METHOD - exhaust fan for each HILS, approximately 8 CFM per HILS.

LAMP BASE TEMPERATURE - (Safe operating temperature = 300°C) 230°C

FILM TEMPERATURE AT INCREASED LUMINANCE LEVELS - see chart.



FILM TEMP. RISE ABOVE AMBIENT

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CONCLUSIONS

Specification Conformance

- Tungsten light pack meets or exceeds all specifications except uniformity of spot.
- Uniformity worse case is 30% at edge of spot only.

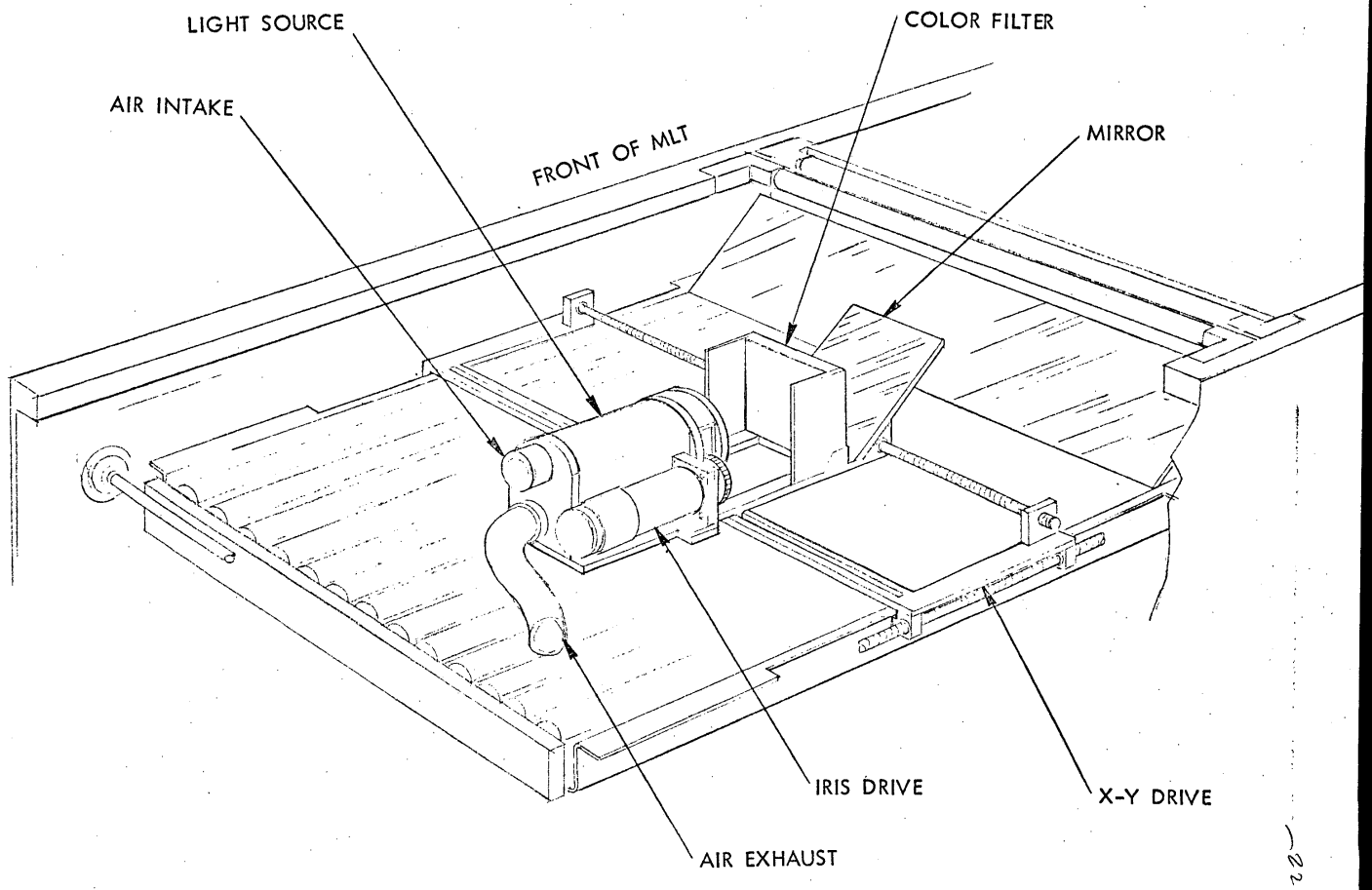
Tungsten Light Pack

- Less costly than arc source
- Smaller than arc source
- Requires no external power supply
- Lower power consumption than arc source
- Safer than arc source.

RECOMMENDATION

Tungsten light pack with ELH 300 watt lamp, with electric servo controlled X,Y drive and tracking system.

H.I.L.S. CONFIGURATION



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PERFORMANCE

TUNGSTEN LIGHT PACK THROUGH MICROSCOPE

Numerical Aperture Illumination Comparison
3x ASR, NA .206, 10x Ocular, TR-70 Diffuser over HILS

	Luminance Target	Luminance 3x Zoom	Effectiveness
HILS	23,000	500	
MLT	2,850	70	
Ratio $\frac{\text{HILS}}{\text{MLT}}$	8.0	7.2	.90
		2.0 Zoom	
	22,000	500	
	2,850	69	
Ratio	7.8	7.3	.94
		0.7 Zoom	
	22,500	530	
	2,800	70	
Ratio	8.0	7.6	.95

Luminance Transmission of Microscope
3x ASR, 3x Zoom, 10x Ocular, MLT Source
82 Ft. Lamberts through microscope
3350 Ft. Lamberts MLT target

$$T = 2.4 \times 10^{-2}$$

Binocular viewing through one rhomboid

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